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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 354)

AUGUST 8, 1997

01
AERONAUTICS

19970021150 Army Aviation Systems Command, Army Aeroflightdynamics Directorate, Moffett Field, CA USA
An Empirical Correction Method for Improving off-Axes Response Prediction in Component Type Flight Mechanics Helicopter Models
Mansur, M. Hossein, Army Aviation Systems Command, USA; Tischler, Mark B., Army Aviation Systems Command, USA; Feb. 1997; 16p; In English
Contract(s)/Grant(s): RTOP 505-59-36
Report No.(s): NASA-TM-110406; NAS 1.15:110406; USAATCOM-96-A-010; A-961022; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Historically, component-type flight mechanics simulation models of helicopters have been unable to satisfactorily predict the roll response to pitch stick input and the pitch response to roll stick input off-axes responses. In the study presented here, simple first-order low-pass filtering of the elemental lift and drag forces was considered as a means of improving the correlation. The method was applied to a blade-element model of the AH-64 APache, and responses of the modified model were compared with flight data in hover and forward flight. Results indicate that significant improvement in the off-axes responses can be achieved in hover. In forward flight, however, the best correlation in the longitudinal and lateral off-axes responses required different values of the filter time constant for each axis. A compromise value was selected and was shown to result in good overall improvement in the off-axes responses. The paper describes both the method and the model used for its implementation, and presents results obtained at hover and in forward flight.
Author
Lift; Aerodynamic Drag; AH-64 Helicopter; Correction; Models; Low Pass Filters

19970021984 Oregon Univ., Computational intelligence Research Lab., Eugene, OR USA
AASERT93/Real-Time Control of Reasoning ***Final Report, 1 Sep. 1993 - 31 Aug. 1996***
Ginsberg, Matthew L., Oregon Univ., USA; Oct. 30, 1996; 4p; In English
Contract(s)/Grant(s): F49620-93-I-0572; AF Proj. 3484
Report No.(s): AD-A321479; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This AASERT award supported students working on the development of next-generation planning and scheduling systems. Students supported by the award contributed directly to both the development and implementation of these systems. The dissertations completed involved the theoretical investigation of reason maintenance and dynamic backtracking and their practical impact on search engines, and the development of a new search technique known as 'limited discrepancy search' that has been successfully implemented at a variety of external sites. Limited discrepancy search has also been incorporated in a CIRL-developed tool that develops manufacturing schedules, and the technique has produced the best known solution on realistic problems related to aircraft manufacture. Another AASERT-supported student interfaced the scheduling tool to Microsoft Project, demonstrating both the flexibility of the method and its applicability to a wide range of problems. The parent AFOSR award involved planning research as well, and two of the five supported students have worked on problems fundamental to the development of more effective automated planning systems. This has included the development of specialized planning tools for simplified domains and an investigation of the reasons that these systems are effective, and a formal investigation of the role of causality in representations of commonsense knowledge about actions, and the impact such representations will have on planning systems.
DTIC
Systems Engineering; Real Time Operation; Numerical Analysis; Man Machine Systems

19970021985 Air Force Inst. of Tech., Air Education and Training Command, Wright-Patterson AFB, OH USA
Information Requirements Analysis: A Qualitative Characterization of the Flightline Expediter for the Integrated Maintenance Information System
Gorla, John C., Jr, Air Force Inst. of Tech., USA; Sep. 1996; 107p; In English
Report No.(s): AD-A321590; AFIT/GLM/LAR/96S-3; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Integrated Maintenance Information System (IMIS) concept design includes the addition of management tools to access IMIS databases and provide communication capabilities between flightline technicians and supervisors. Armstrong Laboratory has developed a portable maintenance aid for technicians, and sponsored this research to investigate the requirements for a computer based tool for the expediter, The basic hardware and software requirements document for IMIS, the System/Segment Specification (SSS), contains task information that closely corresponds to the expediter job description as defined in Air Combat Command Instruction 21-166. This research compiled a list of information requirements for the expediter from the IMIS SSS and analyzed the resulting information using subjective evaluation and theoretical foundations in linguistics. The results support the notion that the expediter is often an intermediary to maintenance information. The recommendations focused on freeing the expediter to do more important tasks by reengineering the information flow in IMIS, which could result in significant workload reductions for the expediter with proper design of the information processes in an IMIS context.
DTIC
Information Systems; Workloads (Psychophysiology); Linguistics; Education

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

19970020673 California Univ., Dept. of Aerospace Engineering, Los Angeles, CA USA
Dynamical Effects of Delta Wing Actuators on Streamwise Vortices in Boundary Layers ***Final Report, 1 Nov. 1994 - 30 Jun. 1996***
Blackwelder, Ron F., California Univ., USA; Nov. 07, 1996; 3p; In English
Contract(s)/Grant(s): N00014-95-I-0030
Report No.(s): AD-A317667; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Small delta wing actuators have been constructed and employed in a turbulent boundary layer to provide a disturbance in the wall region. The actuators oscillate perpendicular to the wall with small amplitudes of a few viscous scales. The oscillations set up a spanwise flow of low speed fluid near the wall that coagulates into low speed regions. Since other investigators have found that a spanwise flow near the wall can reduce the drag on the bounding surface, these actuators may be a convenient method to introduce such a spanwise velocity in the near wall region.
DTIC
Turbulent Boundary Layer; Vortices; Wind Tunnel Tests; Actuators; Wind Tunnel Walls

19970020905 Kyushu Univ., Faculty of Engineering., Fukuoka, Japan
An Experimental Study on Dynamic Stall Phenomena around a 2-Dimensional Airfoil Oscillating in Low Pitch
Aso, Shigeru, Kyushu Univ., Japan; Kumamoto, Yuichi, Kyushu Univ., Japan; Technology Reports of Kyushu University; Mar. 1995; Volume 68, No. 2, pp. 129-136; In Japanese; Also announced as 19970020903; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Dynamic stall phenomena have been investigated experimentally by many researchers. However, as the phenomena are essentially nonlinear and the flow field becomes complicated as the separated region increases, they are not understood sufficiently. In the present study, experimental and computational efforts have been exerted in order to reveal the detailed structure of the dynamic stall in low speed flows. In the present experiments, a low speed wind tunnel, whose diameter is 2 m, was used at a very low freestream of 2 m/s in order to ensure laminar flow for comparison with numerical simulations. A special device for making the airfoil pitch sinusoidally was developed by using a mechanical system. The flow fields were visualized by a smoke-wire method and smoke lines (streak line) were recorded with a conventional camera and a video camera. The mean angle of attack of the airfoil and the reduced frequency were changed variously and the effects of those parameters on the characteristics of the dynamic stall were investigated carefully. The results show that the dynamic stall characteristics in low speed flow are significantly influenced by the mean angle of attack and the reduced frequency.
Author (revised)
Aerodynamic Stalling; Airfoils; Wind Tunnel Tests; Airfoil Oscillations

19970021307 National Aerospace Lab., Tokyo, Japan

Employment of k-epsilon Turbulence Model for Finite-Element Analysis of Flows over Single- and Multi-Component Airfoils

Shigemi, Masashi, National Aerospace Lab., Japan; Ito, Fumiko, National Aerospace Lab., Japan; Dec. 1996; ISSN 0389-4010; 22p; In Japanese

Report No.(s): NAL-TR-1316; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Finite-element analysis code to solve incompressible Navier-Stokes equations was incorporated into the k-epsilon turbulence model of high Reynolds number type, and was applied to flows around single- and multi-component aerofoils. Although the relevant equations are highly nonlinear and, therefore, their solutions are easy to diverge, the employment of the implicit Euler scheme for time marching integral and the introduction of background turbulence in the uniform flow made it possible to obtain stable solutions. For gentle flows produced around airfoils at moderate angles of attack or airfoils with a flap and slat at moderate deflection angles, the computed pressure distributions around the airfoils and lift coefficients as well are in good agreement with measured results. The effectiveness of the turbulence model for such complicated flows was confirmed. For the flows which oscillated periodically or corresponded to airfoils at high angles of attack, however, there was less agreement between computed and measured results. to solve a large-scale linear equation system, which was necessitated by the adoption of the implicit Euler scheme, a newly developed code for the direct method was used successfully.

Author

K-Epsilon Turbulence Model; Finite Element Method; Airfoils; Navier-Stokes Equation; Computational Fluid Dynamics; Angle of Attack; Incompressible Flow

19970021349 NASA Langley Research Center, Hampton, VA USA

Static Investigation of a Multiaxis Thrust-Vectoring Nozzle With Variable Internal Contouring Ability

Wing, David J., NASA Langley Research Center, USA; Mills, Charles T. L., NASA Langley Research Center, USA; Mason, Mary L., NASA Langley Research Center, USA; Jun. 1997; 150p; In English

Contract(s)/Grant(s): RTOP 505-59-30-24

Report No.(s): NASA-TP-3628; NAS 1.60:3628; L-17570; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The thrust efficiency and vectoring performance of a convergent-divergent nozzle were investigated at static conditions in the model preparation area of the Langley 16-Foot Transonic Tunnel. The diamond-shaped nozzle was capable of varying the internal contour of each quadrant individually by using cam mechanisms and retractable drawers to produce pitch and yaw thrust vectoring. Pitch thrust vectoring was achieved by either retracting the lower drawers to incline the throat or varying the internal flow-path contours to incline the throat. Yaw thrust vectoring was achieved by reducing flow area left of the nozzle centerline and increasing flow area right of the nozzle centerline; a skewed throat deflected the flow in the lateral direction.

Author

Thrust Vector Control; Convergent-Divergent Nozzles; Nozzle Flow; Transonic Wind Tunnels; Static Models; Contours; Internal Flow

19970021470 National Aerospace Lab., Computational Science Div., Tokyo, Japan

Mathematical Theory on Difference Approximation of Scalar Conservation Law

Hideaki, Aiso, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 1-6; In English; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

We review mathematical theory on difference approximation for scalar conservation law from the viewpoint of numerical viscosity. We present a new result as well. The most important thing in the theory is to prove the convergence to entropy solution (physically relevant solution). For this purpose, we discuss the consistency with entropy condition. On the other hand, high accuracy is strongly required from the practical viewpoint. It is still an open problem to determine a general class of difference approximations which both converge to the entropy solution and are of high accuracy. Our objective is to give a clear overview of the theory from the viewpoint of numerical viscosity. We classify the difference approximations by numerical viscosity coefficient. by using this method, we can clearly determine classes of difference approximation which converge to entropy solution. Our new theorem determines a general class of highly accurate difference approximations converging to the entropy solution. The new class is one of the widest class of such difference approximations, and the theorem is important practically as well as theoretically.

Author

Scalars; Conservation Laws; Convergence; Entropy

19970021472 Tohoku Univ., Dept. of Aeronautics and Space Engineering, Miyagi, Japan

Higher-Order Shock-Vortex Capturing for Unsteady Internal and External Flows

Yamamoto, Satoru, Tohoku Univ., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 13-18; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Some complicated unsteady flow problems involving shocks and vortices are numerically investigated. Numerical methods employed in the present research are composed of the higher-resolution shock capturing schemes in space difference, based on the fourth-order compact MUSCL TVD scheme coupled with an efficient approximate Riemann solver, and the maximum second-order accurate implicit schemes. Some typical calculated results are shown. The first case is the unsteady transonic flow problem through a turbine cascade tunnel. The second case is the unsteady transonic flow around a NASA airfoil at high angle of attack, and the third case is the unsteady hypersonic shock/shock interference flow known as the type 4 shock heating problem. Finally, the reliability of the so-called shock-vortex capturing method is discussed.

Author

Vortices; Unsteady Flow; Internal Flow; Shock Waves; TVD Schemes; Hypersonic Shock; Transonic Flow

19970021478 National Aerospace Lab., Tokyo, Japan

On Flight Data of Hyflex

Watanabe, Shigeya, National Aerospace Lab., Japan; Shirouzu, Masao, National Aerospace Lab., Japan; Yamamoto, Masataka, National Space Development Agency, Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 43-48; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

HYFLEX (Hypersonic Flight Experiment), which was planned for the development of the Japanese unmanned orbiting plane, HOPE, was successfully conducted on 12 Feb. 1996. The vehicle used in the experiment has a 4.4 m-long slender body configuration whose gross weight is 1073 kg. Various hypersonic lifting flight data on aerodynamics, thermal protection system, and guidance & control were acquired during the flight. In this paper, the following flight data in respect to hypersonic aerodynamics are briefly reviewed: aerodynamic characteristics, aerodynamic heating, pressure measurements for ADS (Air Data Sensor) and RCS gas-jet interaction experiment, and electron density around the vehicle. The data are compared with the preflight predictions based on wind tunnel test results and CFD calculations in order to investigate validity of the prediction methods.

Author

Hypersonic Flight; Aerodynamic Characteristics; Aerodynamic Heating; Pressure Measurement; Electron Density (Concentration); Data Acquisition

19970021479 National Aerospace Lab., Tokyo, Japan

CFD Analysis for Hypersonic Flight Experiment (HYFLEX)

Takaki, Ryoji, National Aerospace Lab., Japan; Ito, Takeshi, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 49-54; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

In HYFLEX, reflectometer measurements were performed to research the blackout phenomena during hypersonic or re-entry flight. Reflection intensity and phase of radio wave were measured by reflectometer. Flight data analysis is composed of two steps. First step is the calculation of distribution of electron number density around the vehicle by using a CFD code including the real gas effects. Second step is performing the radio wave reflection analysis. by using this radio wave reflection analysis, we can get reflection intensity and phase of radio wave and compare these results with the flight data. In this paper, we show the outline of the reflectometer measurement in HYFLEX. Also the CFD code, including the real gas effects is described. Calculation results, especially free electron density distributions along the flight trajectory are presented. At some points on the flight trajectory, we calculated reflection intensity and compared it with the flight data. Some results of the calculations which change thermal model, 2-temperature model and 1-temperature model or surface condition, fully catalytic surface and non-catalytic surface, are also presented.

Author

Hypersonic Flight; Electron Density (Concentration); Computational Fluid Dynamics; Wave Reflection; Radio Waves

19970021480 National Aerospace Lab., Tokyo, Japan

CFD Analysis and Experiment of Aerothermodynamic Heating around Re-Entry Vehicle

Yamamoto, Yukimitsu, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 55-60; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Recent comparisons of hypersonic CFD analysis with hypersonic wind tunnel experiments, including NAL M10 HWT, ONERA S4MA HWT, Calspan's shock tunnel and Caltech T-5 high enthalpy shock tunnel, are introduced. Also, hypersonic re-entry flight analysis, such as OREX and HYFLEX are performed. Through these studies, aerothermodynamic heating characteristics of the re-entry vehicle are investigated in detail.
Author
Hypersonic Flight; Aerodynamic Heating; Aerothermodynamics; Reentry Vehicles; Reentry; Computational Fluid Dynamics; Wind Tunnel Tests

19970021482 National Aerospace Lab., Tokyo, Japan
Validation of the Computation of Hypersonic Flow with Real Gas Effects
Kishimoto, Takuji, National Aerospace Lab., Japan; Hanamitsu, Akira, National Aerospace Lab., Japan; Bito, Hideo, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 67-72; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The validation of the computation of hypersonic flow with real gas effects, assumed to be in chemical equilibrium, have been carried out by comparison with the HEG (High Enthalpy Shock Tunnel in Gottingen) shock tunnel test data. Our flow analysis system uses a structured multi-block grid, and is based on finite volume TVD upwind scheme with the curve fitting to estimate chemical equilibrium real gas effects. Calculations were done for the flows around a sphere and the simple wing-body model, respectively. The numerical results of the flow around a sphere showed very good agreement with the shock tunnel test data in relation to heat flux at a stagnation point. The results of the simple wing-body model were qualitatively improved by taking into account the real gas effects with respect to the location and value of peak heat flux by shock-shock interaction, compared with frozen flow results.
Author
Real Gases; Hypersonic Flow; Computational Fluid Dynamics; Upwind Schemes (Mathematics); Multiblock Grids; Finite Volume Method; TVD Schemes; Curve Fitting

19970021486 Fujitsu Ltd., Tokyo, Japan
An Inverse Design Method for Multiple Wing Systems with Interaction
Matsushima, Kisa, Fujitsu Ltd., Japan; Takanashi, Susumu, National Aerospace Lab., Japan; Iwamiya, Toshiyuki, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 89-94; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An inverse design method that treats multiple wings (or multi-components of a wing) is examined from the viewpoint of the effect of interaction between wings on the wing shape design. This new method has been devised recently by the authors on the basis of Takanashi's integral equation method. It takes into consideration the mutual interaction between wings to provide section shapes of wings which realize a specified surface pressure distribution. This method works well on several preliminary design problems. It is found that both aerodynamic mutual interaction and the correlation between the geometrical change of a certain wing and that of the others should be considered for efficient and accurate design.
Author
Wings; Wing Profiles; Aerodynamics; Design Analysis

19970021487 National Aerospace Lab., Tokyo, Japan
On an Inverse Problem for a Supersonic Airfoil Based on the Navier-Stokes Approximation
Kamiya, Nobuhiko, National Aerospace Lab., Japan; Tamaki, Hidemi, National Aerospace Lab., Japan; Hirose, Naoki, National Aerospace Lab., Japan; Ishida, Yoji, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 95-100; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Takanashi's iterative residual-correction method is applied to the design of supersonic airfoils. Airfoil geometry correction is obtained by use of inverse solutions calculated from the differences between the computed and the prescribed pressure distributions. Inverse solutions are obtained by Prandtl-Meyer function or linearized theory. The pressure distributions are obtained numerically by the code NSFOIL, where Navier-Stokes approximations are used. Some examples of the calculations are presented.
Author
Airfoil Profiles; Supersonic Airfoils; Iterative Solution; Design Analysis

19970021488 National Aerospace Lab., Tokyo, Japan

On a Inverse Problem for a Low Aspect Ratio Wing

Kamiya, Nobuhiko, National Aerospace Lab., Japan; Hattori, Keisuke, National Aerospace Lab., Japan; Takanashi, Susumu, National Aerospace Lab., Japan; Hirose, Naoki, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 101-106; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Takanashi's method for calculating wing geometry based on pressure distributions at transonic speeds is useful for wings of large aspect ratio. The calculations by this method, however, sometimes diverge for wings of low aspect ratio. In this paper this method is modified to be applied to the wings of low aspect ratio. Examples of the calculations are presented.
Author

Aspect Ratio; Wing Profiles; Transonic Speed; Wings

19970021489 National Aerospace Lab., Tokyo, Japan

Three-Dimensional Aerodynamic Optimization

Oyama, Akira, National Aerospace Lab., Japan; Obayashi, Shigeru, National Aerospace Lab., Japan; Nakahashi, Kazuhiro, National Aerospace Lab., Japan; Nakamura, Takashi, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 107-112; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A Genetic Algorithm(GA) has been applied to optimize a wing aerodynamic shape for generic subsonic transport aircraft using Navier-Stokes computations. Conventional optimization schemes are not suitable for aerodynamic optimization problems as they fall into a local optimum. Since a GA searches multi-directionally, the resulting aerodynamic optimization algorithm finds a global optimum. Moreover, the algorithm itself is very simple and thus very robust, however, a GA needs enormous computational time. Previous study indicates that 2-D optimization of airfoil shape with GA and Navier-Stokes calculation needs several hundred CPU time on CRAY C90 single processor. From this study, we realize that 3-D optimization with GA will require unacceptable CPU time even on a supercomputer. Thus, any 3-D optimization of wing shape has been never done before with a GA and Navier-Stokes calculation even though Navier-Stokes calculation is necessary to evaluate L/D of a wing precisely. In this study, to overcome enormous CPU time necessary for this optimization, spanwise maximum thickness and twist angle distributions are selected as design variables, the multigrid technique is applied to the 3-D Navier-Stokes computation, and the computation is parallelized in Numerical Wind Tunnel at National Aerospace Laboratory, which is a parallel vector machine with 166 processing elements. The objective of the present optimization is to maximize L/D of wing shape. to avoid apparent solution of zero thickness wing for low drag in high speed, a structural constraint is considered. In the optimum design obtained from the present GA, the design principles for the wing developed by existing theory and experience are found to be materialized. This indicates feasibility of the present approach for the aerodynamic optimization in advanced computational environments.
Author

Genetic Algorithms; Navier-Stokes Equation; Aerodynamic Configurations; Wings; Transport Aircraft; Multigrid Methods; Computational Fluid Dynamics

19970021490 National Aerospace Lab., Tokyo, Japan

Optimization of Wing Planform with Structural Constrains

Yamaguchi, Yoshihiro, National Aerospace Lab., Japan; Obayashi, Shigeru, National Aerospace Lab., Japan; Nakahashi, Kazuhiro, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 113-118; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

In the field of aerospace engineering, the aircraft design process can be divided into three stages: conceptual, preliminary and detail designs. The conceptual design is the first stage to decide a direction of design from mission requirements. In this process, the initial sizing of the aircraft is estimated from existing database and empirical methods. Since there are various demands for aerodynamics, structures, fuel, payload, and so on, a multiobjective optimization is necessary for the design. Therefore, in this paper, an optimization method is investigated to design wing planforms for this stage. Three objectives are considered for wing planform optimization: aerodynamic performance, wing weight, and fuel tank volume. Aerodynamic performance is evaluated by CFD analysis. Wing weight and fuel tank volume are estimated by empirical formulae. to simplify the problem, only the leading-edge sweep angle and two chord lengths at the midspan and wingtip are used as design variables. The leading edge of the wing is kept straight. Thus, a tapered wing with a trailing-edge kink will be designed. As an optimizer, Genetic Algorithm (GA) is employed here. GA simulates evolution by selection. Because GA can find a more global optimum, it is expected to perform better than the conventional gradient-based methods. Major drawback of GA is that it requires a large number of function evaluations. Thus, FLO-22 code based on the full potential equation is used because of its efficiency, instead of Euler or Navier-Stokes solver.

Planform optimization problems are considered for typical subsonic aircraft. The design results show the feasibility of the present approach for the initial sizing with optimization.
Author
Wing Planforms; Genetic Algorithms; Design Analysis

19970021501 National Aerospace Lab., Tokyo, Japan
Aerodynamic Analysis of the Flow Switch Devices
Shimizu, Kunihiro, National Aerospace Lab., Japan; Nakanishi, Hidemasa, National Aerospace Lab., Japan; Miyake, Yoshiaki, National Aerospace Lab., Japan; Higashimori, Hirotaka, National Aerospace Lab., Japan; Nozaki, Osamu, National Aerospace Lab., Japan; Kikuchi, Kazuo, National Aerospace Lab., Japan; Tamura, Atsuhiro, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 177-182; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The variable bypass fan engine is proposed as an engine configuration to reduce noise at take-off and landing and to obtain high specific thrust during supersonic flight. The Flow Switch Device is one of the methods to change bypass ratio. 3D Viscous Analysis was conducted to obtain aerodynamic characteristics of the Flow Switch Device, which were later compared with test results. The analysis qualitatively predicted the total pressure loss at the exit side of the Flow Switch Device, and was found to be a useful design tool.
Author
Noise Reduction; Supersonic Flight; Bypass Ratio; Engine Noise; Turbofan Engines

19970021517 Kyushu Univ., Dept. of Aeronautics and Astronautics, Fukuoka, Japan
Numerical Simulation of Dynamic Stall Phenomena for an Airfoil Oscillating in Coupled Pitching and Heaving
Isogai, Koji, Kyushu Univ., Japan; Shinmoto, Yasuhisa, Kyushu Univ., Japan; Watanabe, Yohachirou, Mitsubishi Heavy Industries Ltd., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 275-284; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Numerical simulation of dynamic stall phenomena around an airfoil oscillating in a coupled mode, where the pitching and heaving oscillations have some phase differences has been performed using the Navier-Stokes code. The propulsive efficiency and the thrust have been calculated for various combinations of the phase difference and the reduced frequency for two different feathering parameters, and the effects of the dynamic stall phenomena on the behavior of the propulsive efficiency and thrust are also discussed in detail by examining each flow pattern obtained. The highest efficiency has been observed for the case where the pitching oscillation advances 90 deg over the heaving oscillation, for which the flow separation is confined in the small region on the airfoil surface near the trailing edge in spite of the large amplitude oscillations. For phase angles other than 90 deg, the efficiency is degraded by the occurrence of the large scale leading edge separation.
Author
Aerodynamic Stalling; Navier-Stokes Equation; Computational Fluid Dynamics; Flow Distribution; Separated Flow; Airfoil Oscillations

19970021522 Fuji Heavy Industries Ltd., Tokyo, Japan
Numerical Analysis of Supersonic Transport's Leading-Edge Vortex Flaps
Higaki, Kyoko, Fuji Heavy Industries Ltd., Japan; Maekawa, Shoji, Japan Aircraft Development Corp., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 307-313; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The supersonic transports often have a delta or delta-like wing as the main wing. It is known that the lift-to-drag ratio of a delta or delta-like wing during a take-off and landing condition is not very good. The leading-edge vortex flap can improve the lift-to-drag ratio of the wing by forming a leading-edge vortex on the flap. The 3-D Navier-Stokes calculation was carried out to clarify the flow field around the supersonic transport cranked arrow wing equipped with the leading-edge vortex flaps.
Author
Supersonic Transports; Delta Wings; Vortex Flaps; Leading Edge Flaps; Lift Drag Ratio; Navier-Stokes Equation; Computational Fluid Dynamics; Flow Distribution

19970021556 Defense Group, Inc., Arlington, VA USA
An Analysis of the Pressures, Forces and Moments Induced by the Ground Vortex Generated by a Single Impinging Jet
Kuhn, Richard E., Defense Group, Inc., USA; Feb. 1997; 102p; In English
Contract(s)/Grant(s): NAS2-14384; RTOP 505-68-32

Report No.(s): NASA-CR-4765; NAS 1.26:4765; A-975988; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

When a jet STOVL aircraft is in STOL operation the jets impinge on the ground and generate wall jets flowing radially outward from the points at which the jets impinge. When the forward flowing part of a wall jet meets the free stream flow it is rolled back on itself forming a parabolic shaped ground vortex. Positive pressures are induced on the lower surface of the configuration ahead of the ground vortex and suction pressures are induced over the ground vortex itself. In addition, the suction pressures induced aft of the jet out of ground effect are reduced and lifting pressures are induced on the upper surface. This study analyzes available pressure and force data and develops a method for estimating the forces and moments induced in ground effect. The method includes the effects of configuration variables, height and operating conditions, as well as the effects of the location, deflection and shape of the jet. However, it is limited to single jets at subcritical nozzle pressure ratios. An analysis of the effects of moving over the ground vs. tests over a fixed ground plane is included.

Author

STOVL Aircraft; Vortices; Ground Effect (Aerodynamics); Wall Jets; Pressure Distribution; Lift; Pitching Moments

19970021749 NASA Ames Research Center, Moffett Field, CA USA

Reducing Wind Tunnel Data Requirements Using Neural Networks

Ross, James C., NASA Ames Research Center, USA; Jorgenson, Charles C., NASA Ames Research Center, USA; Norgaard, Magnus, Technical Univ. of Denmark, Denmark; May 1997; 16p; In English

Contract(s)/Grant(s): RTOP 519-20-22

Report No.(s): NASA-TM-112193; NAS 1.15:112193; A-976463; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of neural networks to minimize the amount of data required to completely define the aerodynamic performance of a wind tunnel model is examined. The accuracy requirements for commercial wind tunnel test data are very severe and are difficult to reproduce using neural networks. For the current work, multiple input, single output networks were trained using a Levenberg-Marquardt algorithm for each of the aerodynamic coefficients. When applied to the aerodynamics of a 55% scale model of a U.S. Air Force/ NASA generic fighter configuration, this scheme provided accurate models of the lift, drag, and pitching-moment coefficients. Using only 50% of the data acquired during, the wind tunnel test, the trained neural network had a predictive accuracy equal to or better than the accuracy of the experimental measurements.

Author

Neural Nets; Wind Tunnel Models; Wind Tunnel Tests; Data Reduction; Aerodynamic Characteristics; Aerodynamic Drag; Pitching Moments; Accuracy

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

19970021742 NASA Ames Research Center, Moffett Field, CA USA

Comprehensive Analysis of Two Downburst-Related Aircraft Accidents

Shen, J., Texas Univ., USA; Parks, E. K., Arizona Univ., USA; Bach, R. E., NASA Ames Research Center, USA; Journal of Aircraft; Oct. 1996; Volume 33, No. 5, pp. 924-930; In English; 34th; Aerospace Sciences Meeting and Exhibit, 15 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NCC2-329

Report No.(s): NASA-CR-204549; NAS 1.26:204549; AIAA Paper 96-0895; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Although downbursts have been identified as the major cause of a number of aircraft takeoff and landing accidents, only the 1985 Dallas/Fort Worth (DFW) and the more recent (July 1994) Charlotte, North Carolina, landing accidents provided sufficient onboard recorded data to perform a comprehensive analysis of the downburst phenomenon. The first step in the present analysis was the determination of the downburst wind components. Once the wind components and their gradients were determined, the degrading effect of the wind environment on the airplane's performance was calculated. This wind-shear-induced aircraft performance degradation, sometimes called the F-factor, was broken down into two components F(sub 1) and F(sub 2), representing the effect of the horizontal wind gradient and the vertical wind velocity, respectively. In both the DFW and Charlotte cases, F(sub 1) was found to be the dominant causal factor of the accident. Next, the aircraft in the two cases were mathematically modeled using the longitudinal equations of motion and the appropriate aerodynamic parameters. Based on the aircraft model and the determined winds, the aircraft response to the recorded pilot inputs showed good agreement with the onboard recordings. Finally, vari-

ous landing abort strategies were studied. It was concluded that the most acceptable landing abort strategy from both an analytical and pilot's standpoint was to hold constant nose-up pitch attitude while operating at maximum engine thrust.
Author
Downbursts; Aircraft Accidents; Wind Shear; Flight Characteristics; Equations of Motion; Flight Safety; Aviation Meteorology

19970021976 Armstrong Lab., Crew Systems Directorate, Wright-Patterson AFB, OH USA
The K-36D Ejection Seat Foreign Comparative Testing (FCT) Program ***Interim Report, 4 Mar. 1993 - 31 Dec. 1994***
Specker, Lawrence J., Armstrong Lab., USA; Plaga, John A., Armstrong Lab., USA; May 1996; 437p; In English
Contract(s)/Grant(s): AF Proj. 2868
Report No.(s): AD-A321294; AL/CF-TR-1996-0099; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

In 1989 at the Paris Air Show, a K-36D ejection seat gained wide public attention when the pilot successfully ejected from a MiG.29 after an extremely low altitude engine failure. The K-36D is standard equipment in Russian high-performance aircraft, being rated for survivable ejections at speeds of 0-755 KEAS. In 1993, a Foreign Comparative Testing (FCT) Program was initiated to evaluate the Soviet designed K-36D ejection seat. The objectives of this program were to increase USAFIUSN knowledge of the state of Russian ejection seat technology, confirm or refute Russian claims on the performance of the K-36D ejection seat and associated personnel equipment, determine the relevance of Soviet ejection seat technology and fight crew equipment to development of a technology base for expansion of the performance envelope of USAF/USN escape systems and to develop working relationships between the US and Russian technical teams. The program consisted of eight ejections from modified MiG-25 aircraft at altitudes up to 56,000 ft at Mach 2.5, and three rocket sled tests at speeds up to 755 KEAS. This report discusses the K-36 FCT Program and the results of the ejection testing, comparing the performance of the K-36D to that of current Western ejection seats. In 1989 at the Paris Air Show, a K-36D ejection seat gained wide public attention when the pilot successfully ejected from a MiG.29 after an extremely low altitude engine failure. The K-36D is standard equipment in Russian high-performance aircraft, being rated for survivable ejections at speeds of 0-755 KEAS.
DTIC
Escape Systems; Aircraft Safety; Flying Ejection Seats; Escape Capsules

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

19970020670 Veda, Inc., Dayton, OH USA
The APG-70 Radar Simulation Model ***Final Report, 21 Sep. 1994 - 31 Mar. 1996***
Garcia, Lucy, Veda, Inc., USA; Gehl, Dave, Veda, Inc., USA; Buell, Chris, Veda, Inc., USA; Hassoun, John, Veda, Inc., USA; Sep. 1996; 168p; In English
Contract(s)/Grant(s): F33615-93-D-3800; AF Proj. 2403
Report No.(s): AD-A319223; VEDA-63351-96U/P61213; WL-TR-96-3126; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report describes contract activities that were completed by Veda Incorporated and Hughes Training Incorporated from September 1994 through March 1996 under DO 0013 of the Pilot Factors Contract F33615-93-D-3800. Specifically, this report summarizes the long term requirements that drove the development of an APG-70 radar capability and the PVI of the radar, as integrated into the CSIL simulation facility. This report also summarizes the design considerations, design approach, design implementation, and the current status of the overall software development. In addition, recommendations are identified within the report to further the integration and fidelity of the APG-70 radar simulation within CSIL. The sections devoted to the software design architecture and implementation are provided so that a proficient software engineer will be able to thoroughly understand the software design and the implementation without having to review the source code.
DTIC
Software Engineering; Computerized Simulation; Synthetic Aperture Radar; F-15 Aircraft; Man Machine Systems; Computer Programs

19970021346 National Oceanic and Atmospheric Administration, Washington, DC USA
Analytical Model of Refraction in a Moist Polytropic Atmosphere for Space and Ground-Based GPS Applications
Rosenfeld, Simon, National Oceanic and Atmospheric Administration, USA; Apr. 1997; 56p; In English
Report No.(s): NOAA-TR-NESDIS-88; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An analytical model has been developed to treat the problems of large scale atmospheric refractometry. The model accounts for both dry and moist components of refractivity as well as for the decrease of temperature with height in the lower troposphere. The model takes into account sphericity of the Earth and is applicable for all possible elevation angles from zenith to horizon. The model is intended to be used for the interpretation of GPS remote sensing for both ground-based and space-based Global Positioning System (GPS) receivers. Also, the model may be used for calculation of refractive angles and delays in precise geodesy, astronomy, and VLBI. Within the model the following problems are considered: refractive angles and delays of signals arriving at a ground- based receiver from an extraterrestrial GPS or stellar source, refractive angles and delays of GPS signals arriving at the receiver onboard a Low Earth Orbiter. The sensitivity of refraction to variations of tropospheric thermodynamical parameters is studied. The impact of horizontal inhomogeneity on refraction in both ground and space-based configurations is evaluated.
Author
Mathematical Models; Refraction; Polytropic Processes; Global Positioning System; Troposphere

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970020680 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Investigation of Fatigue Cracking on LAU-7/A Launcher Housing
Saunders, D. S., Defence Science and Technology Organisation, Australia; Stimson, M. G., Defence Science and Technology Organisation, Australia; Bailey, R., Defence Science and Technology Organisation, Australia; Kowal, E., Defence Science and Technology Organisation, Australia; Sep. 1995; 73p; In English
Report No.(s): AD-A315330; DSTO-TR-0229; DODA-TR-0229; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A number of LAU-7/A launcher housings on Australian F/A-18 aircraft have been found to be fatigue cracked at the location of the forward missile hanging bracket. This was initially ascribed to poor aft snubbing of the missile in the launcher guide rail. An investigation of the response of the LAU-7/A launcher housing configuration to static and fatigue loading was undertaken to determine the failure mechanism. A test fixture was designed to apply static loads to a launcher housing via a dummy AIM-9 missile. The results showed that the strains at the points of engagement of the missile hanging brackets with the launcher guide rail were not significantly inf luenced by the effectiveness of the aft snubbing of the missile. The launcher housing was then fatigue tested using spectrum loading. The loads applied to the test articles were derived from a number of Nz load spectra of Australian F/A-18 aircraft. The load levels were factored up to account for the dynamic effects of the flexible wings of the aircraft. to ascertain whether the loads achieved in the experimental study were appropriate for the fatigue testing of the component, the fracture surfaces derived from the fatigue test were compared with several surfaces removed from launcher housings which had failed under operational loads. The results showed that the use of 'factored' Nz loads was only an approximate simulation of the wing tip environment, but in the absence of a wing tip spectrum these loads gave approximately similar fatigue fracture surfaces to those of the components in service. The results showed that the cracking was largely induced by the inertial loads experienced by the missile, which are transferred to the guide rails of the LAU-7/A housing.
DTIC
Fatigue Tests; Missile Launchers; Loads (Forces); Launchers; Fracturing; Failure

19970021181 Defence Science and Technology Organisation, Aeronautical and Maritime Reserch Lab., Melbourne, Australia
The referred weight flight test technique applied to first of class flight trials
Arney, A. M., Defence Science and Technology Organisation, Australia; Apr. 1997; 34p; In English
Report No.(s): DSTO-TR-0509; AR-010-178; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P O Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

This report illustrates the relationships between power requirements, control positions, and W/sigma(sub rho) by first using simplified equations to derive the mathematical relationship. The referred weight flight test technique has been used by the RAN to establish Ship Helicopter Operating Limits for a number of years. This technique involves keeping the referred weight, defined as aircraft weight divided by density ratio, constant for a given flight test. The validity of using this technique has been questioned within the RAN, specifically with respect to its relevance and application to power and flight control margins. This report illustrates the relationships between power requirements, flight control positions, and referred weight by first using simplified equations to derive the mathematical relationships. to verify these relationships, the simulation code GenHel, which allows for many of the complex factors ignored in deriving the simplified equations, has been applied over a wide range of conditions. Results suggest that the referred weight technique is valid for conditions typically encountered during First of Class Flight Trials. The

defence outcome of this work is progress towards safe definitions of the operational capability of maritime helicopters in embarked operations.
Author (revised)
Flight Tests; Structural Weight; Weight (Mass)

19970021182 NASA Ames Research Center, Moffett Field, CA USA
Wing Weight Optimization Under Aeroelastic Loads Subject to Stress Constraints ***Final Report***
Kapania, Rakesh K., Virginia Polytechnic Inst. and State Univ., USA; Issac, J., Virginia Polytechnic Inst. and State Univ., USA; Macmurdy, D., Virginia Polytechnic Inst. and State Univ., USA; Guruswamy, Guru P., NASA Ames Research Center, USA; Apr. 30, 1997; 44p; In English
Contract(s)/Grant(s): NCC2-5036
Report No.(s): NASA-CR-204315; NAS 1.26:204315; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A minimum weight optimization of the wing under aeroelastic loads subject to stress constraints is carried out. The loads for the optimization are based on aeroelastic trim. The design variables are the thickness of the wing skins and planform variables. The composite plate structural model incorporates first-order shear deformation theory, the wing deflections are expressed using Chebyshev polynomials and a Rayleigh-Ritz procedure is adopted for the structural formulation. The aerodynamic pressures provided by the aerodynamic code at a discrete number of grid points is represented as a bilinear distribution on the composite plate code to solve for the deflections and stresses in the wing. The lifting-surface aerodynamic code FAST is presently being used to generate the pressure distribution over the wing. The envisioned ENSAERO/Plate is an aeroelastic analysis code which combines ENSAERO version 3.0 (for analysis of wing-body configurations) with the composite plate code.
Author
Wing Loading; Optimization; Aeroelasticity; Stress Analysis; Body-Wing Configurations

19970021237 NASA Langley Research Center, Hampton, VA USA
Texture Modification of the Shuttle Landing Facility Runway at Kennedy Space Center
Daugherty, Robert H., NASA Langley Research Center, USA; Yager, Thomas J., NASA Langley Research Center, USA; May 1997; 54p; In English
Contract(s)/Grant(s): RTOP 505-63-50-19
Report No.(s): NASA-TP-3626; NAS 1.60:3626; L-17550; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This paper describes the test procedures and the criteria used in selecting an effective runway-surface-texture modification at the Kennedy Space Center (KSC) Shuttle Landing Facility (SLF) to reduce Orbiter tire wear. The new runway surface may ultimately result in an increase of allowable crosswinds for launch and landing operations. The modification allows launch and landing operations in 20-knot crosswinds, if desired. This 5-knot increase over the previous 15-knot limit drastically increases landing safety and the ability to make on-time launches to support missions in which Space Station rendezvous are planned. The paper presents the results of an initial (1988) texture modification to reduce tire spin-up wear and then describes a series of tests that use an instrumented ground-test vehicle to compare tire friction and wear characteristics, at small scale, of proposed texture modifications placed into the SLF runway surface itself. Based on these tests, three candidate surfaces were chosen to be tested at full-scale by using a highly modified and instrumented transport aircraft capable of duplicating full Orbiter landing profiles. The full-scale Orbiter tire testing revealed that tire wear could be reduced approximately by half with either of two candidates. The texture-modification technique using a Humble Equipment Company Skidabrader(trademark) shotpeening machine proved to be highly effective, and the entire SLF runway surface was modified in September 1994. The extensive testing and evaluation effort that preceded the selection of this particular surface-texture-modification technique is described herein.
Author
Runways; Wear; Surface Properties; Spacecraft Launching; Tires; Ground Tests

19970021267 NASA Langley Research Center, Hampton, VA USA
Research and Applications in Aeroelasticity and Structural Dynamics at the NASA Langley Research Center
Abel, Irving, NASA Langley Research Center, USA; May 1997; 22p; In English
Contract(s)/Grant(s): RTOP 522-32-21-01
Report No.(s): NASA-TM-112852; NAS 1.15:112852; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An overview of recently completed programs in aeroelasticity and structural dynamics research at the NASA Langley Research Center is presented. Methods used to perform flutter clearance studies in the wind-tunnel on a high performance fighter are discussed. Recent advances in the use of smart structures and controls to solve aeroelastic problems, including flutter and gust response are presented. An aeroelastic models program designed to support an advanced high speed civil transport is described.

An extension to transonic small disturbance theory that better predicts flows involving separation and reattachment is presented. The results of a research study to determine the effects of flexibility on the taxi and takeoff characteristics of a high speed civil transport are presented. The use of photogrammetric methods aboard Space Shuttle to measure spacecraft dynamic response is discussed. Issues associated with the jitter response of multi-payload spacecraft are discussed. Finally a Space Shuttle flight experiment that studied the control of flexible spacecraft is described.
Author
Dynamic Structural Analysis; Aeroelasticity; Flutter; Wind Tunnels; Smart Structures; Dynamic Response

19970021297 NASA Ames Research Center, Moffett Field, CA USA
Development of an Automatic Grid Generator for Multi-Element High-Lift Wings ***Final Report***
Eberhardt, Scott, Washington Univ., USA; Wibowo, Pratomo, Washington Univ., USA; Tu, Eugene, NASA Ames Research Center, USA; 1996; 54p; In English
Contract(s)/Grant(s): NCC2-5152
Report No.(s): NASA-CR-204631; NAS 1.26:204631; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The procedure to generate the grid around a complex wing configuration is presented in this report. The automatic grid generation utilizes the Modified Advancing Front Method as a predictor and an elliptic scheme as a corrector. The scheme will advance the surface grid one cell outward and the newly obtained grid is corrected using the Laplace equation. The predictor-corrector step ensures that the grid produced will be smooth for every configuration. The predictor-corrector scheme is extended for a complex wing configuration. A new technique is developed to deal with the grid generation in the wing-gaps and on the flaps. It will create the grids that fill the gap on the wing surface and the gap created by the flaps. The scheme recognizes these configurations automatically so that minimal user input is required. by utilizing an appropriate sequence in advancing the grid points on a wing surface, the automatic grid generation for complex wing configurations is achieved.
Author
Grid Generation (Mathematics); Predictor-Corrector Methods; Wings; Computational Grids; Laplace Equation; Aerodynamic Configurations

19970021351 NASA Langley Research Center, Hampton, VA USA
Rotating Shake Test and Modal Analysis of a Model Helicopter Rotor Blade
Wilkie, W. Keats, Army Research Lab., USA; Mirick, Paul H., Army Research Lab., USA; Langston, Chester W., Army Research Lab., USA; Jun. 1997; 20p; In English
Contract(s)/Grant(s): RTOP 505-63-36-02
Report No.(s): NASA-TM-4760; NAS 1.15:4760; L-17352; ARL-TR-1389; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Rotating blade frequencies for a model generic helicopter rotor blade mounted on an articulated hub were experimentally determined. Testing was conducted using the Aeroelastic Rotor Experimental System (ARES) testbed in the Helicopter Hover Facility (HBF) at Langley Research Center. The measured data were compared to pretest analytical predictions of the rotating blade frequencies made using the MSC/NASTRAN finite-element computer code. The MSC/NASTRAN solution sequences used to analyze the model were modified to account for differential stiffening effects caused by the centrifugal force acting on the blade and rotating system dynamic effects. The correlation of the MSC/NASTRAN-derived frequencies with the experimental data is, in general, very good although discrepancies in the blade torsional frequency trends and magnitudes were observed. The procedures necessary to perform a rotating system modal analysis of a helicopter rotor blade with MSC/NASTRAN are outlined, and complete sample data deck listings are provided.
Author
Rotary Wings; Helicopters; Systems Analysis; Computer Programs; Centrifugal Force; Finite Element Method; Aeroelasticity

19970021376 National Aerospace Lab., Tokyo, Japan
Maximum-likelihood Estimation of the NAL Spaceplane Aerodynamic Model using Dynamic Wind Tunnel Tests
Sep. 1996; ISSN 0389-4010; 16p; In Japanese
Report No.(s): NAL-TR-1307; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As a part of a study of the estimation of aircraft aerodynamic characteristics using dynamic wind tunnel tests, cable-mount dynamic wind tunnel tests have been performed since 1989. Maximum likelihood estimation algorithm is applied to the test data,

and low speed aerodynamic parameters are estimated. The basic performance of the algorithm is evaluated by comparing it to the other estimation algorithm.
Author
Maximum Likelihood Estimates; Wind Tunnel Tests; Spacecraft Models; Dynamic Tests; Parameter Identification; Aerodynamic Characteristics

19970021491 National Aerospace Lab., Tokyo, Japan
Aerodynamic Design and CFD Evaluation of a High Speed Commercial Transport
Yamakami, Katsuhiko, National Aerospace Lab., Japan; Nakahasi, Kazuhiro, National Aerospace Lab., Japan; Obayashi, Sigeru, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 119-124; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

At present, the Concorde is the only operating high speed commercial transport (HSCT) in the world. However, it has many economical and environmental problems and research programs for next generation HSCT have been carried out by many countries. In developing the next, more economical generation of HSCT, an improvement of the lift-to-drag ratio is the most important item. The objective of this research is to construct a practical aerodynamic design system for a HSCT with high lift-to-drag ratio. The system is based on the linearized theory method and the supersonic area rule concept. The linearized theory method is applied to optimize the three dimensional wing camber line so as to achieve the minimum drag due to lift. The supersonic area rule concept is applied to optimize the fuselage configuration so as to give the cross sectional area distribution for the minimum wave drag. The performance of the designed configuration is evaluated by solving the Euler equations on unstructured grid. The comparison of the results between Euler computation and the linearized theory is made, and a discussion to obtain a more sophisticated design system using CFD is presented.
Author
Computational Fluid Dynamics; Supersonic Transports; Lift Drag Ratio; Wing Camber; Unstructured Grids (Mathematics)

19970021707 Air Force Academy, Dept. of Aeronautics, CO USA
Cessna 150/Lycoming O-320-E2D Limited Performance Evaluation ***Final Report, 3 Jul. 1995 - 16 May 1996***
Erb, Russell E., Air Force Academy, USA; Fernand, Jean M., Air Force Academy, USA; Oct. 1996; 180p; In English
Report No.(s): AD-A320789; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

This report presents the results of a limited performance evaluation of the USAF Academy Cadet Competition Flying Team Cessna 150. Each aircraft was fitted with a Lycoming 0-320-E2D engine of 150 horsepower. The general objective of this evaluation was to determine the modified Cessna 150 performance characteristics for purposes of generating flight manual performance charts. Flight test data were reduced and used to develop a computer model of the aircraft using the Reciprocating Engine and Propeller Modeling Program (RPM). This computer model was then used to create performance charts and tabulated data for the flight regimes tested for inclusion in the next update of the Flight Manual. No changes to existing Flight Manual performance speeds were recommended. Additional testing was recommended to investigate any performance differences between airframes and to further validate the performance charts presented in this report.
DTIC
Cessna Aircraft; Piston Engines; Horsepower; Flight Tests; Airframes

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19970021332 Federal Aviation Administration, Willian J. Hughes Technical Center, Atlantic City, NJ USA
Evaluation of Dual Simultaneous Instrument Landing System Approaches to Runways Spaced 3000 Feet Apart with One Localizer Offset Using a Precision Runway Monitor System ***Final Report***
Ozmore, Richard E., Federal Aviation Administration, USA; Morrow, Sherri L., Federal Aviation Administration, USA; Sep. 1996; 159p; In English
Contract(s)/Grant(s): FAA-2006-D1
Report No.(s): AD-A319234; DOT/FAA/CT-96/2; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

A real time simulation was conducted to evaluate simultaneous ILS approaches to two runways spaced 3000 ft apart with one localizer offset by 2.5 degrees. Air traffic controllers monitored traffic using a simulated Precision Runway Monitor (PRM) system which consisted of Final Monitor Aid (FMA) displays and a simulated radar update rate of 1.0 second. Aircraft blunders

were introduced to test the air traffic control system ability to maintain adequate separation between aircraft on final approaches during critical situations using the proposed runway configuration. Four criteria were developed by the Multiple Parallel Approach Program (MPAP) Technical Work Group to evaluate the study: (1) the number of Test Criterion Violations (TCVs) relative to the total number of at-risk, non-responding blunders, and relative to a predetermined target level of safety of no more than one fatal accident per 25,000,000 approaches; (2) the frequency of No Transgression Zone (NTZ) entries and nuisance breakouts (NBOs); (3) an evaluation of controller communications workload; and (4) an operational assessment from MPAP TWG members and participating controller and pilot technical observers. The results of the simulation passed all of the test criteria The MPAP TWG recommended the 3000-ft dual offset procedure for approval in the operational environment, given similar controller and pilot training, when the PRM system is used.
DTIC
Evaluation; Landing Instruments; Performance Tests; Instrument Landing Systems

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19970021452 Naval Facilities Engineering Service Center, Port Hueneme, CA USA
Development and Analysis of the Naval Facilities Engineering Service Center Aviation Engine Simulation Facility ***Final Report, Oct. 1990 - Sep. 1996***
Cooper, Eugene E., Naval Facilities Engineering Service Center, USA; Oct. 1996; 187p; In English
Report No.(s): AD-A320720; NFESC-TR-2065-SHR; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

This report documents the development of the Naval Facilities Engineering Service Center (NFESC) Aviation Engine Simulation Facility (AESF). The objective of this effort was to develop a facility which can repetitively expose candidate pavement specimens to convective heat transfer rates equal to those which pavements at operational airfields experience due to jet exhaust impingement. Damage of concrete pavements has become a chronic problem at Navy, Marine Corps and Air Force bases. The damage is due to impingement of vertically directed jet exhaust flow from auxiliary power unit (APU) engines of the F/A-18 and B-1 aircraft, and from the main propulsion engines of the AV-8B aircraft during vertical takeoff and landing. The main component of the AESF is a burner and nozzle assembly in which there is combustion of natural gas. by controlling the combustion chamber pressure and temperature, along with the nozzle diameter and distance from the specimen, the AESF can impose convective heating rates on the specimen that equal the heating rates imposed on operational airfields by full scale engines. The experimental data validated the applicability of the exhaust simulation. Specimens can be repetitively exposed to the simulated exhaust flow to evaluate their performance under the simulated exhaust conditions.
DTIC
Test Facilities; Aircraft Engines; Simulation; Pavements; Convective Heat Transfer; Jet Exhaust; Impingement; Landing Sites

19970021628 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
The Cassini Main Engine Assembly Cover Mechanism
Sevilla, Donald R., Jet Propulsion Lab., California Inst. of Tech., USA; Thirty-first Aerospace Mechanisms Symposium; May 1997, pp. 197-213; In English; Also announced as 19970021613; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper describes a micrometeroid protection system for the main engines of the Cassini spacecraft. The engine Cover Assembly is a deployable/restowable half sphere of multilayer insulation mounted to an articulatable frame over 2 meters (7 feet) in diameter. The Cover folds into a compact wedge only 25 cm (10 inches) at its maximum thickness. The micrometeroid environment and typical protection methods are described as well as the design details and development problems of the Cover Mechanism Assembly.
Author
Spacecraft Shielding; Meteoroid Protection; Multilayer Insulation; Electromechanical Devices; Design

19970021709 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Multidisciplinary and Multiobjective Optimization in Conceptual Design for Mixed-Stream Turbofan Engines
Nadon, Luc J., Air Force Inst. of Tech., USA; Dec. 1996; 175p; In English
Report No.(s): AD-A320800; AFIT/GAE/ENY/96D-6; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Despite major advances in design tools such as engine cycle analysis software and computer aided design, conceptual gas turbine engine design is essentially a trial-and-error process based on the experience of engineers. Modern optimization concepts, such as multidisciplinary optimization (MDO), and multiobjective optimization (MOO), linked with sequential quadratic programming (SQP) methods and genetic algorithms (GA), were applied to the conceptual engine design process to automate the conceptual design phase. Robust integrated computer codes were created to find the optimal values of eight engine parameters in order to minimize fuel usage, aircraft cost and engine annulus area over a given mission. The engine cycle selected for study was the mixed stream, low bypass turbofan. SQP and GA optimization algorithms were integrated with on-design and off- design engine cycle analysis and mission analysis computer codes created by the authors to obtain the optimized conceptual engine design for an imaginary short range interceptor and the Global Strike Aircraft U.S. Air Force concept. The process used a nonspecific approach that can be applied to a wide variety of missions and aircraft. All the codes were written in Matlab, and so operate under the same programming architecture and can be easily upgraded or modified.
DTIC
Computer Aided Design; Turbofan Engines; Multidisciplinary Design Optimization; Engine Design; Computer Programs; Military Aircraft; Aircraft Engines

19970021745 Michigan Technological Univ., Mechanical Engineering-Engineering Mechanics Dept., Houghton, MI USA
Evaluation of Water Injection Effect on NO(x) Formation for a Staged Gas Turbine Combustor
Fan, L., Michigan Technological Univ., USA; Yang, S. L., Michigan Technological Univ., USA; Kundu, K. P., NASA Lewis Research Center, USA; 1996; 11p; In English; 34th; Aerospace Sciences Meeting and Exhibit, 15-18 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NCC3-406; NAG3-1109
Report No.(s): NASA-CR-204769; NAS 1.26:204769; AIAA Paper 96-0706; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

NO(x) emission control by water injection on a staged turbine combustor (STC) was modeled using the KIVA-2 code with modification. Water is injected into the rich-burn combustion zone of the combustor by a single nozzle. Parametric study for different water injection patterns was performed. Results show NO(x) emission will decrease after water being injected. Water nozzle location also has significant effect for NO formation and fuel ignition. The chemical kinetic model is also sensitive to the excess water. Through this study, a better understanding of the physics and chemical kinetics is obtained, this will enhance the STC design process.
Author
Reaction Kinetics; Water Injection; Combustion Chambers; Gas Turbines; Combustion

19970022007 NASA Lewis Research Center, Cleveland, OH USA
Application of the kappa-omega Turbulence Model to Quasi-Three-Dimensional Turbomachinery Flows
Chima, Rodrick V., NASA Lewis Research Center, USA; J. Propulsion: Technical Notes; 1996; Volume 12, No. 6, pp. 1176-1179; In English; 34th; Aerospace Sciences, 15-19 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA-TM-112767; NAS 1.15:112767; AIAA Paper 96-0248; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Many computational fluid dynamics codes for turbomachinery use the Baldwin-Lomax (B-L) turbulence model. It is easy to implement in two dimensions and works well for predicting overall turbomachinery performance. However, it is awkward to implement in three dimensions, often has difficulty finding the length scale, has a crude transition model, and neglects freestream turbulence, surface roughness, and mass injection. The kappa-omega model developed by Wilcox is an appealing alternative for several reasons. First, it is the only two-equation model that can be integrated to the wall without requiring damping functions or the distance to the wall, and hence, should behave well numerically. Second, the effects of freestream turbulence, surface roughness, and mass injection are easily included in the model. Finally, transition can be simulated using the low Reynolds number version of the model. Menter applied the kappa-model to external flows and showed very good results for flows with adverse pressure gradients. Liu and Zheng described their implementation of the kappa-model in a cascade code that included an area change term to account for endwall convergence. They validated the model for a flat plate, and compared the B-L and kappa-models to measured surface pressures for a low-pressure turbine cascade. Since they did not use the low Reynolds number version of the model, their results showed problems resulting from early transition. In this Note the low Reynolds number kappa-model was incorporated in the author's quasi-three-dimensional turbomachinery analysis code. The code includes the effects of rotation, radius change, and stream-surface thickness variation, and also includes the B-L turbulence model. The kappa-omega model was implemented using many of Menter's recommendations and an implicit approximate-factorization scheme described by Baldwin

and Barth. The model was tested for a transonic compressor with rotation and variable stream-surface radius and height, and for a transonic turbine vane with transition and heat transfer. Results were compared to the B-L model and to experimental data.
Author
Baldwin-Lomax Turbulence Model; K-Omega Turbulence Model; Turbulence Models; Turbomachinery; Three Dimensional Models; Navier-Stokes Equation

19970022131 Analytical Services and Materials, Inc., Edwards, CA USA
Inlet Distortion for an F/A-18A Aircraft During Steady Aerodynamic Conditions up to 60 deg Angle of Attack
Walsh, Kevin R., NASA Dryden Flight Research Center, USA; Yuhas, Andrew J., Analytical Services and Materials, Inc., USA; Williams, John G., General Electric Co., USA; Steenken, William G., General Electric Co., USA; Apr. 1997; 48p; In English; High-Angle-of-Attack Technology, 17-19 Sep. 1996, Hampton, VA, USA
Contract(s)/Grant(s): NAS3-26617; RTOP 505-68-30
Report No.(s): NASA-TM-104329; NAS 1.15:104329; H-2173; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects of high-angle-of-attack flight on aircraft inlet aerodynamic characteristics were investigated at NASA Dryden Flight Research Center, Edwards, California, as part of NASA's High Alpha Technology Program. The highly instrumented F/A-18A High Alpha Research Vehicle was used for this research. A newly designed inlet total-pressure rake was installed in front of the starboard F404-GE-400 engine to measure inlet recovery and distortion characteristics. One objective was to determine inlet total-pressure characteristics at steady high-angle-of-attack conditions. Other objectives include assessing whether significant differences exist in inlet distortion between rapid angle-of-attack maneuvers and corresponding steady aerodynamic conditions, assessing inlet characteristics during aircraft departures, providing data for developing and verifying computational fluid dynamic codes, and calculating engine airflow using five methods. This paper addresses the first objective by summarizing results of 79 flight maneuvers at steady aerodynamic conditions, ranging from -10 deg to 60 deg angle of attack and from -8 deg to 11 deg angle of sideslip at Mach 0.3 and 0.4. These data and the associated database have been rigorously validated to establish a foundation for understanding inlet characteristics at high angle of attack.
Author
F-18 Aircraft; Angle of Attack; Aerodynamic Characteristics; Computational Fluid Dynamics; Pressure Recovery; Subsonic Speed

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

19970022035 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Model Predictive Control of Aerospace Systems
Ebdon, Derek W., Air Force Inst. of Tech., USA; Dec. 1996; 143p; In English
Report No.(s): AD-A321470; AFIT/GAE/ENY/96D-3; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The primary objective of this thesis is to explore the fault tolerance capabilities of a state space formulation of MPC. Subsequent to a simulated control surface failure on the F-18 High Alpha Research Vehicle (HARV), the MPC controller will attempt to maintain stability and nominal performance while tracking a setpoint. Secondary objectives include studying the effect of data sample rate and MPC horizon lengths on system performance. These objectives will be accomplished using Matlab to develop the MPC controller and Simulink to demonstrate its effectiveness through simulation.
DTIC
Aerospace Systems; Simulation; Automatic Control

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19970021141 Institute for Human Factors TNO, Soesterberg, Netherlands
Feasibility of integration of driving simulators *Final Report Haalbaarheid van integratie van rijsimulatoren*
Padmos, P., Institute for Human Factors TNO, Netherlands; deVries, S. C., Institute for Human Factors TNO, Netherlands;

Feb. 24, 1997; 23p; In Dutch
Contract(s)/Grant(s): A96/KL/343
Report No.(s): TM-97-A012; TD-97-0173; Copyright; Avail: Issuing Activity (TNO Human Factors Research Inst., Kampweg 5, 3769 De Soesterberg, The Netherlands), Hardcopy, Microfiche

In order to obtain more accurate estimates of the technical design, a feasibility study is performed after the technical possibilities to combine the training of drivers for four types of wheel vehicles Mercedes 290 GD, LSV, UN vehicle, FENNEK) in one driving simulator. It appeared that this integration is possible, be it that the dynamic vehicle models and the driver's compartments must be made separately for the four vehicles. The cost saving for training tools that occurs, compared with the procurement of four separate simulators, is estimated at Mfl. 10-26. to obtain more accurate and more detailed estimates of the technical design of an integrated simulator, author recommended to set up further research into the training goals and the connected functional requirements of an integrated stimulator. Based on these functional requirements, more accurate cost estimates may be obtained. Author (revised)

Feasibility Analysis; Simulators; Dynamic Models; Education

19970021373 Naval Facilities Engineering Service Center, Port Hueneme, CA USA
Advantages and Disadvantages of Three-Layer Raised Computer Flooring
Kistler, Paul, Naval Facilities Engineering Service Center, USA; Nov. 1996; 5p; In English
Report No.(s): AD-A320654; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

A traditional single-layer raised computer floor often combines three functions; routing space for low-voltage signaling cables between computer, routing space for high-voltage power cables to computers, and plenum to supply cool air to prevent computers from overheating. A three-layer raised floor separates these functions into three separate layers; the top layer houses the low voltage signal cables, the middle layer houses the high voltage power cables, and the lower layer is a sealed plenum with 'chimneys' to supply cool air where required.

DTIC

Local Area Networks; Low Voltage; Computers

19970021710 Federal Aviation Administration, John A. Volpe National Transportation Systems Center, Cambridge, MA USA
Evaluation of an Out-of-the-Window Air Traffic Control Tower Simulation for Controller Training ***Final Report, Dec. 1993 - Aug. 1996***
Nadler, Eric, Federal Aviation Administration, USA; Sep. 1996; 59p; In English
Report No.(s): AD-A319227; DOT-VNTSC-FAA-96-14; DOT/FAA/AR-96/107; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This study gathered evidence concerning the potential usefulness of out-of-the-window air traffic control tower simulation for training tower controllers. Data were collected from all ten developmental controllers who completed simulation training at Chicago O'Hare International Airport during 1994. The simulation included one controller position, outbound ground control. An out-of-the-window view was projected on three visual displays which approximated the size of actual tower windows. Aircraft were representative of O'Hare, and appeared to move in three dimensions on the displays. The simulation could display the entire airport, but only 135 degrees could be seen at a time and no inbound aircraft were simulated. After five weeks of simulation training, the trainees became certified on outbound ground control in 25% fewer days than trainees who received the same amount of traditional training. However, the trainees using the simulation needed only slightly (5%) fewer total hours to become certified on this tower position. Evidence suggested that the simulation increased the trainees' working speed, enabling them to work under busier conditions, and hence more hours per day. Expert ratings of eight ground control skills based on actual tower observations were all higher following simulation training than following traditional training.

DTIC

Ground Based Control; Air Traffic Control; Airport Towers

19970022118 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Design of the Stop Plate and Stop Bolt for the Uniport ***Final Report***
Crowell, Harrison P., III, Army Research Lab., USA; Jan. 1997; 28p; In English
Contract(s)/Grant(s): DA Proj. 1L1-62716-AH-70
Report No.(s): AD-A321225; ARL-TN-84; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report has two main purposes. The first is to document the problems with the previous system for limiting rotation of the Uniport. The second purpose is to document the design of the new system to limit rotation of the Uniport. (The Uniport consists of a unicycle type mobility platform, which allows a person to 'pedal' his or her way through the virtual environment.) The pre-

vious system for limiting rotation consisted of a steel cable attached to a support structure at one end and bolted to the turntable at the other end. This system suffered from two main problems. The moment arm for the bolt holding the cable was so long that it created large stresses in the bolt, which caused it to fail by fatigue. The other main problem was that the cable twisted and kinked, which caused some of the strands of the cable to break. The new system for limiting rotation has been designed to resist fatigue failure and failure from impact loading. The stop plate and stop bolt provide an effective and reliable means to limit rotation of the Uniport.
DTIC
Systems Engineering; Mobility; Design Analysis; Fabrication; Metal Plates; Virtual Reality

10
ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

19970021239 NASA Johnson Space Center, Houston, TX USA
X-38 Vehicle 131 Flutter Assessment
Smith, James P., NASA Johnson Space Center, USA; May 1997; 30p; In English
Report No.(s): NASA-TP-3683; NAS 1.60:3683; S-826; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Contained herein are the findings from the X-38 vehicle flutter prediction program at the NASA/Johnson Space Center. The results presented show the 131 vehicle to be flutter free in the maximum flight profile of q = 500 psf.
Author
Flutter Analysis; Aerodynamic Characteristics; Aerodynamic Forces; X-38 Crew Return Vehicle; Aerodynamic Balance; Damping; Rudders; Fins

11
CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19970021277 NASA Langley Research Center, Hampton, VA USA
Combustibility Tests of 1,1,1,2-tetrafluoroethane in a Simulated Compressor Cylinder
Babcock, Dale A., NASA Langley Research Center, USA; Bruce, Robert A., NASA Langley Research Center, USA; Jun. 1997; 26p; In English
Contract(s)/Grant(s): RTOP 505-63-50-13
Report No.(s): NASA-TP-3633; NAS 1.60:3633; L-17584; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The advantages of high-molecular-weight gas (heavy gas) as a wind-tunnel medium have been recognized for some time. The current heavy gas of choice chlorofluorocarbon-12(CFC-12) (refrigerant R12) for the Transonic Dynamics Tunnel(TDT) must be replaced because manufacture of this gas ceased in 1995. An attractive replacement is 1,1,1,2-tetrafluoroethane (refrigerant R134a). Acceptable properties of this gas include molecular weight and speed of sound. Its vapor pressure allows simplified reclamation from mixtures with air. However, it is recognized that R134a is combustible under certain conditions of temperature, pressure, and concentration. A comprehensive study was conducted to identify those conditions and the influence of various parameters on the combustibility of the gas-air mixture.
Author
Combustion; Chlorocarbons; Refrigerants; Gas Mixtures; Transonic Wind Tunnels

19970021498 National Defense Academy, Japan
Forced Ignition Effect by a Plasma Torch on Supersonic Combustion
Obata, Shigeo, National Defense Academy, Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 159-164; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The most effective plasma injection state, atomic oxygen in diffuse mode, is applied for forced ignition within a two-dimensional supersonic shear flow, constructed between supersonic air and sonic gas hydrogen. The effect of plasma forced ignition has been investigated by the molecular gas dynamical numerical approach. The Direct Simulation Monte Carlo (DSMC) method based on the Boltzmann equation has been employed with reactive inelastic molecular collision model (IE Model) as a numerical analysis method. It is clarified that plasma torch is able to act as an ignitor for supersonic combustion with a low temperature condition.
Author
Plasma Torches; Supersonic Combustion; Shear Flow; Two Dimensional Flow; Monte Carlo Method; Combustion Efficiency

19970021644 Cambridge Univ., Engineering Dept., Cambridge, UK
Turbulent Combustion
Bray, Ken, Cambridge Univ., UK; Turbulence in Compressible Flows; Jun. 1997, pp. 3.1-3.74; In English; Also announced as 19970021641; Copyright Waived; Avail: CASI; A04, Hardcopy; A03, Microfiche

This review is concerned with turbulent combustion in high speed flows. Its aim is to assess the current state of knowledge incorporated in theoretical models and, as with most turbulent flows, these models necessarily involve averaging. Because high speed turbulent combustion involves additional phenomena which are not well understood, we begin by considering combustion at low Mach numbers where a substantial body of theory exists. Our purpose is to identify the key role played by the low Mach number assumption and hence to define the particular challenge posed by high Mach number reactive flows. Experiments concerning high speed turbulent combustion in jet flames, high speed turbulent deflagration and transition to detonation are reviewed. Finally, problems involved in modeling and prediction of high speed turbulent combustion are identified and discussed. It is concluded that convincing theoretical models are currently not available.
Author
Turbulent Combustion; Turbulent Flow; Hypersonic Flight; Turbulence Models; Jet Flow; Turbulence Effects; Fuel Combustion; Combustion Chemistry

19970021711 Allied-Signal Aerospace Co., Phoenix, AZ USA
Damage Tolerance Concepts for Titanium-Aluminide Composites ***Final Report, 13 Sep. 1989 - 13 Dec. 1994***
Hall, J. A., Allied-Signal Aerospace Co., USA; Peralta, A., Allied-Signal Aerospace Co., USA; Hollars, R. L., Allied-Signal Aerospace Co., USA; Harmon, D., McDonnell Aircraft Co., USA; Finefield, M. A., McDonnell Aircraft Co., USA; Marshall, James D. B., Rockwell International Science Center, USA; Aug. 31, 1995; 356p; In English
Contract(s)/Grant(s): F33615-89-C-5621; AF Proj. 2420
Report No.(s): AD-A320765; Rept-21-8755; WL-TR-95-4089; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

Titanium-Aluminide metal matrix composites (MMCs) provide one of the enabling technologies needed in achieving the objectives of the Integrated High Performance Turbine Engine Technology (IHPTET) Initiative. These materials are targeted for applications that require high-temperature strength and stiffness, high creep and oxidation resistance, and acceptable ductility and fatigue resistance. The damage Tolerance Concepts for Titanium-Aluminide Composites Program addresses life management and reliability issues. Specific objectives of this program were to develop and establish design tools, behavior models, inspection methods, and Engine Structural Integrity Program (ENSIP) strategies required for alpha-two MMC fracture-critical components. DTIC
Tolerances (Mechanics); Structural Failure; Turbine Engines; Titanium; Gas Turbine Engines; Fracturing; Fracture Strength; Fatigue (Materials); Engine Design

12
ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19970021469 National Aerospace Lab., Tokyo, Japan
Proceedings of the National Aerospace Laboratory Symposium on Aircraft Computational Aerodynamics
Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996; ISSN 0289-260X; 325p; In Japanese; In English; 14th, 6-7 Jun. 1996, Tokyo, Japan; Sponsored by National Aerospace Lab., Japan; Also announced as 19970021470 through 19970021522

Report No.(s): NAL-SP-34; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

Topics covered include: Upwind schemes in CFD; numerical simulations of wall turbulence by finite difference method; a new high resolution scheme for the solution of compressible Navier-Stokes equations; numerical investigation of unsteady flow through turbomachinery on parallel computers; CFD analysis for Hypersonic Flight Experiment; CFD analysis and experiments of aerothermodynamic heating around reentry vehicles; an inverse problem for a supersonic airfoils based on Navier-Stokes approximation; three-dimensional aerodynamic optimization; and aerodynamic design and CFD evaluation of a high speed commercial transport. Also included: Performance evaluation of matrix multiplication with parallelized programs; space marching method on three-dimensional unstructured grid; forced ignition effect by plasma torch on supersonic combustion; unsteady flow analysis of a compressor blade row with inlet distortion; unsteady single stage analysis for a high pressure turbine; grid generation based on CAD data; Monte Carlo direct simulation of jet/rarefied corner flow interaction; numerical simulation of a turbulent annular flow; effect of blade geometry on BVI noise of helicopter rotor; numerical prediction of sonic boom intensity on near field; computational study of incompressible flow by finite difference method; and numerical analysis of supersonic transport's leading edge vortex flaps.

CASI

Computational Fluid Dynamics; Navier-Stokes Equation; Upwind Schemes (Mathematics); Unstructured Grids (Mathematics); Turbulent Flow; Rarefied Gas Dynamics; Incompressible Flow; Hypersonic Flight; Grid Generation (Mathematics); Finite Difference Theory; TVD Schemes

19970021484 Mitsubishi Electric Corp., Kamakura Works, Tokyo, Japan

Effects of Wall Catalysis on the Non-Equilibrium Hypersonic Flow around a Reentry Vehicle

Kurotaki, Takuji, Mitsubishi Electric Corp., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 77-82; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Effects of surface catalysis on the non-equilibrium hypersonic flow around reentry vehicle are discussed by solving Navier-Stokes equations considering non-equilibrium effects. Axisymmetric full Navier-Stokes equations which have chemically and thermally non-equilibrium effects are considered by using Park's two-temperature model and the vibrational relaxation model from the SSH theory. For the time integration, an efficient numerical algorithm of an implicit finite difference method is used, which consists of the combination of LU-SGS scheme and the implicit diagonal method for a source Jacobian matrix. For convective terms, a AUSMDV scheme generalized into the non-equilibrium flow case is applied. Effects of catalytic efficiency on aerodynamic heating rates at the wall around OREX are examined in detail. Numerical analyses are performed at several flight altitudes and compared with flight data. Catalytic efficiency of material at the stagnation point is estimated and it is clear that it shows good agreement with data on similar materials of other vehicles such as the Space Shuttle.

Author

Hypersonic Flow; Reentry Vehicles; Nonequilibrium Flow; Navier-Stokes Equation; Computational Fluid Dynamics; Finite Difference Theory; Aerodynamic Heating

19970021500 Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan

Analysis of Mixing Flow in Front-Mixing Duct of HYPR Engine

Hirai, Kenji, Ishikawajima-Harima Heavy Industries Co. Ltd., Japan; Kodama, Hidekazu, Ishikawajima-Harima Heavy Industries Co. Ltd., Japan; Tamura, Atsuhiro, National Aeronautical Lab., Japan; Kikuchi, Kazuo, National Aeronautical Lab., Japan; Nozaki, Osamu, National Aeronautical Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 171-176; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An axisymmetric Navier-Stokes code was developed to analyze mixing flow in a duct for a turbo-ramjet engine. The three-step Runge-Kutta scheme is used to drive the solution toward a steady state. The Lam-Bremhorst Low-Reynolds number k-epsilon model was used to simulate the effect of turbulence on mixing phenomenon. An experiment using a scaled model duct was conducted to validate the numerical code. The predictions of mixing, mass flow and unsteady pressure fluctuation are mainly compared with the experimental data because they are key issues in the design of the duct. Comparison with experimental data indicated that computed results successfully captured important features of mixing flow phenomenon for steady state.

Author

K-Epsilon Turbulence Model; Runge-Kutta Method; Ramjet Engines; Aircraft Engines; Multiphase Flow; Navier-Stokes Equation; Computational Fluid Dynamics

19970021518 Tokai Univ., Dept. of Aeronautics and Astronautics, Tokyo, Japan

Numerical Simulation of Viscous Unsteady Flow Around a Wing Oscillating in Elastic Modes

Kheirandish, Hamidreza, Tokai Univ., Japan; Beppu, Goro, Tokai Univ., Japan; Nakamichi, Jiro, National Aeronautical Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 285-288; In English; Also announced as 19970021469; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

An aeroelastic version of CFD code was developed and applied to numerical simulations of unsteady transonic flows around a rectangular wing with bioconvex airfoil section oscillating in bending mode, and a wind tunnel model of a high aspect-ratio (YXX) wing which is also oscillating in first bending mode. A numerical simulation of transonic flutter of the YXX wing considering first six modes has been performed as well. The code is based on Navier-Stokes (N-S) equations coupled with the structural equations. The N-S equations arc integrated by Yee-Harten TVD scheme on dynamic grid, while the structural side is integrated by Wilson theta method.

Author

Aeroelasticity; Navier-Stokes Equation; Computational Fluid Dynamics; Viscous Flow; Unsteady Flow; Wing Oscillations; Transonic Flow; TVD Schemes; Transonic Flutter

19970021520 Tokyo Univ., Inst. of Space and Astronautical Science, Sagamihara, Japan

Simulation of Subsonic Flow Past an Airfoil

Kuwahara, Kunio, Tokyo Univ., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 295-300; In English; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Incompressible high-Reynolds-number flows are simulated by solving the Navier-Stokes equations. A finite-difference method with third-order upwinding are employed without using any turbulence model. Also, multi-directional method is used. Unsolved problems in computations around an airfoil are investigated and new results are presented. Using the same approach, we introduce a concept of an airfoil with negative thickness. Application of this concept is suggested.

Author

Computational Fluid Dynamics; Finite Difference Theory; Subsonic Flow; High Reynolds Number; Navier-Stokes Equation; Upwind Schemes (Mathematics); Flow Distribution; Airfoils

19970022000 Stanford Univ., Computer Science Dept., Stanford, CA USA

Signal Structure Methods for Robust Interference Reduction in Airborne Antenna Arrays ***Final Report, 1 Oct. 1993 - 30 Sep. 1996***

Golub, Gene H., Stanford Univ., USA; Feb. 1997; 18p; In English

Contract(s)/Grant(s): MDA972-93-I-0041

Report No.(s): AD-A321612; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Tactical airborne COMmunications INTelligence (COMINT) collection platforms are increasingly faced with multiple spectrally overlapped signals. Direction Finding (DF) and interference reduction for signals of interest in such environments pose significant technical challenges and are a high priority need for the armed forces. Under this contract we have developed a variety of innovative signal processing techniques for DF and interference reduction.

DTIC

Airborne Equipment; Aircraft Communication; Communication Networks; Intelligence

19970022032 Army Aeromedical Research Lab., Aircrew Health and Performance Div., Fort Rucker, AL USA

The Performance of Alkaline AA Batteries with the Aviator's Night Vision Imaging System: Before and After Activation of the Low Battery Indicator ***Final Report***

McLean, Bill, Army Aeromedical Research Lab., USA; Garrard, John A., Army Aeromedical Research Lab., USA; Wildzunas, Robert M., Army Aeromedical Research Lab., USA; Jan. 1997; 30p; In English

Contract(s)/Grant(s): DA Proj. 3M1-62787-A-879

Report No.(s): AD-A321687; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The dual battery pack with the aviator's night vision imaging system (ANVIS) has a low battery indicator to alert the user to switch batteries at approximately 2.4 volts before the ANVIS performance is affected. With the original lithium batteries, the usable time after activation of the low battery indicator is approximately 30 minutes. Aviation units are now predominately using a pair of the AA alkaline batteries with ANVIS. This report investigated the usable time available with ANVIS after activation of the low battery indicator for alkaline AA batteries. Laboratory results showed that the ANVIS usable time for the alkaline batteries was typically more than five hours after the low battery indicator had been activated. Additionally, we found significant differ-

ences in the battery voltages at different airfields for supposedly new batteries, indicating that pilots are either mixing up the new and used batteries during flight, or the batteries are being short-circuited during storage.
DTIC
Alkaline Batteries; Night Vision; Aircraft Pilots; Imaging Techniques; Lithium

19970022145 Fisher-Rosemount, Inc., Eden Prairie, MN USA
Flow Through a Rectangular-to-Semiannular Diffusing Transition Duct
Foster, Jeff, Fisher-Rosemount, Inc., USA; Wendt, Bruce J., Modern Technologies Corp., USA; Reichert, Bruce A., Kansas State Univ., USA; Okiishi, Theodore H., Iowa State Univ. of Science and Technology, USA; Journal of Propulsion and Power; Apr. 1997; Volume 13, No. 2, pp. 312-317; In English; 34th; Aerospace Sciences, 15-18 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAG2-1561
Report No.(s): NASA-CR-204816; NAS 1.26:204816; AIAA Paper 96-0448; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Rectangular-to-semiannular diffusing transition ducts are critical inlet components on supersonic airplanes having bifucated engine inlets. This paper documents measured details of the flow through a rectangular-to-semiannular transition duct having an expansion area ratio of 1.53. Three-dimensional velocity vectors and total pressures at the exit plane of the diffuser are presented. Surface oil-flow visualization and surface static pressure data are shown. The tests were conducted with an inlet Mach number of 0.786 and a Reynolds number based on the inlet centerline velocity and exit diameter of 3.2 x 10(exp 6). The measured data are compared with previously published computational results. The ability of vortex generators to reduce circumferential total pressure distortion is demonstrated.
Author
Engine Inlets; Ducts; Ducted Flow; Flow Visualization; Pressure Reduction; Static Pressure

14
LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

19970021192 Institute for Human Factors TNO, Soesterberg, Netherlands
Quantifying the Image Quality of the KDC-10 Refueling Vision System ***Final Report De Beeldkwaliteit van het KDC-10 Bijtank System***
Kooi, F. L., Institute for Human Factors TNO, Netherlands; Van Breda, L., Institute for Human Factors TNO, Netherlands; Dec. 04, 1996; 22p; In Dutch
Report No.(s): AD-A320634; TNO-TM-96-A052; TDCK-RP96-0195; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The image quantity of the KDC-lO refueling vision system has been evaluated in terms of resolution and contrast sensitivity. to this aim a new contrast test was developed. A comparison to other systems shows that the KDC-lO refueling vision system is particularly tracking in its contrast representation. A recent adjustment to the system partially improved its characteristics. Part of the poor contrast representation is due to the incomplete image separation of the stereoscopic screen. On the basis of a quantitative analysis of the image quality recommendations for further improvement are given.
DTIC
Image Resolution; DC 10 Aircraft; Fuel Systems; Flight Operations; Refueling; Human Factors Engineering

19970021724 Naval Health Research Center, San Diego, CA USA
Aircraft Type and Diagnosed Back Disorders in U.S. Navy Pilots and Aircrew ***Interim Report, 1991 - 1993***
Simon-Arndt, C. M., Naval Health Research Center, USA; Yuan, H., Naval Health Research Center, USA; Hourani, L. L., Naval Health Research Center, USA; Sep. 1996; 29p; In English
Report No.(s): AD-A319230; NHRC-96-27; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Back disorders have long been recognized as a serious problem within the military aviation community and a possible threat to mission accomplishment. The purpose of the present study was to determine the extent to which type of aircraft flown is associated with diagnosed back problems, and to examine differences in the prevalence of back disorders between pilots and aircrew. A case-control study was conducted in which active-duty pilots and aircrew members with a diagnosed back disorder on their most recent physical exam between 1991 and 1993 were compared with pilots and aircrew without such diagnoses. Data were obtained

from the automated physical examination records maintained by the Naval Aerospace and Operational Medical Institute for all naval aviation personnel. Results showed that aircrew members have a higher risk of diagnosed back problems than pilots for both helicopters and fixed-wing aircraft. The study revealed that flight engineers have a higher risk of diagnosed back problems than other aircrew members. Among pilots, no association was found between type of aircraft and diagnosed back problems.
DTIC
Military Aviation; Flying Personnel; Flight Crews; Fixed Wings; Back Injuries

15
MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19970021722 Wright State Univ., Dept. of Mechanical and Materials Engineering, Dayton, OH USA
Multidisciplinary Interactive Design and Analysis System: Architecture ***Interim Report, Sep. 1994 - Dec. 1995***
Rajagopalan, Harini S., Wright State Univ., USA; Luo, Xiao-Dong, Wright State Univ., USA; Grandhi, Ramana V., Wright State Univ., USA; Dec. 1995; 206p; In English
Contract(s)/Grant(s): F33615-94-C-3211; AF Proj. 2401
Report No.(s): AD-A320778; WL-TR-96-3137; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This report presents the development of MIDAS, a graphical pre- and post-processor for ASTROS. The system is developed around I-DEAS using its Open Architecture. MIDAS displays structural responses like stresses, displacements under multiple boundary conditions and load cases. It also displays normal modes animation and concurrent aerodynamic and structural models. Present work concentrates on display of flutter modes, design optimization iteration histories and optimum variables distribution. What-if trade off studies is the future course of the work. MIDAS has been developed on Silicon Graphics workstation and is portable to other UNIX platforms.
DTIC
Structural Analysis; Aircraft Design; Computer Aided Design; Computer Graphics; Aerodynamic Characteristics; Design Analysis

16
PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

19970021481 National Aerospace Lab., Tokyo, Japan
Summary of High Enthalpy Flow Workshop
Yamamoto, Yukimitsu, National Aerospace Lab., Japan; Hosaka, Yoko, Sanko Ltd., Japan; Saito, Akiko, Sanko Ltd., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 61-66; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

In the perspective of Japanese space projects, the knowledge of high enthalpy and high Mach number flow, occurring during the atmospheric reentry of space vehicles, has recently regained considerable interest. The need to support aerodynamic design of space vehicles under the environments where experiment is very difficult and costly, has caused the use of numerical simulation. Hence, a high enthalpy flow workshop was held at NAL in June, 1995 for axisymmetric flow problems. This paper summarizes the computational results of the OREX real gas flow problem and discusses the detailed comparison of numerical results.
Author
Mach Number; Atmospheric Entry; Gas Flow; Numerical Analysis; Aerodynamics; Reentry Vehicles

19970021513 Advanced Technology of Commuter-Helicopter Co., Ltd., Gifu, Japan
Effect of Blade Geometry on BVI Noise of Helicopter Rotor
Nakamura, Hideaki, Advanced Technology of Commuter-Helicopter Co., Ltd., Japan; Kondo, Natsuki, Advanced Technology of Commuter-Helicopter Co., Ltd., Japan; Aoki, Makoto, Advanced Technology of Commuter-Helicopter Co., Ltd., Japan; Aoyama, Takashi, National Aeronautical Lab., Japan; Saito, Shigeru, National Aeronautical Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 251-256; In Japanese; Also announced as 19970021469; No

Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A prediction method for blade-vortex interaction (BVI) noise of a helicopter rotor is developed. This method consists of following four steps: (1) trim analysis using CAMRAD 2 based on the lifting line theory, (2) interpolation of blade motion and the wake geometry, (3) aerodynamic analysis using a finite difference solver for the three-dimensional unsteady Euler equations, and (4) noise analysis using an aeroacoustic code based on the Ffowcs Williams and Hawkings (FW-H) formulation without the quadrupole term. The predicted acoustic waveform for the OLS model rotor is compared with experimental data and reasonable correlation is obtained. This method is applied to investigate the effect of the tip shape on the intensity of the BVI noise. In the first step, the effects of anhedral, dihedral, swept and tapered tip shapes are discussed. As a result, it is shown that the anhedral, swept-forward, and tapered tip shapes are good for the reduction of the BVI noise in a descent flight condition.
Author

Blade Slap Noise; Blade-Vortex Interaction; Blade Tips; Helicopters

19970021514 National Aerospace Lab., Tokyo, Japan

Numerical Analysis of Aerodynamic Noise of Helicopter Rotor

Uchiyama, Naoki, National Aerospace Lab., Japan; Nakao, Masahiro, National Aerospace Lab., Japan; Fuji, Kozo, National Aerospace Lab., Japan; Ohmura, Minoru, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 257-262; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An analysis system for predicting helicopter rotor aerodynamic noise is developed. The system consists of a Navier-Stokes solver for near rotor flowfield computation and an acoustic wave equation solver for computing sound pressure propagation. The Navier-Stokes solver is applied on a system of overset grids in order to allow realistic motion of the rotor blades. The acoustic equation used is the linear Ffowcs Williams and Hawkings equation in Farassat's IA integral formulation. For aerodynamic validation, results obtained from Caradonna's test rotor in hover and AH-1G OLS rotor in forward flight are presented. For aeroacoustic validation, sound pressure history obtained form 1/4 scale UH-I rotor in hover is presented.
Author

Aerodynamic Noise; Navier-Stokes Equation; Computational Fluid Dynamics; Blade Slap Noise; Helicopters; Propeller Noise; Noise Prediction (Aircraft)

19970021515 National Aerospace Lab., Tokyo, Japan

Numerical Prediction of Sonic Boom Intensity in Near-Field

Makino, Yoshikazu, National Aerospace Lab., Japan; Sugiura, Takaaki, National Aerospace Lab., Japan; Watanuki, Tadaharu, National Aerospace Lab., Japan; Kubota, Hirotoshi, National Aerospace Lab., Japan; Aoyama, Takashi, National Aerospace Lab., Japan; Proceedings of the 14th NAL Symposium on Aircraft Computational Aerodynamics; 1996, pp. 263-268; In Japanese; Also announced as 19970021469; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The sonic boom intensity generated by the low-boom designed airplane is estimated numerically. The airplane is designed by using Darden's low-boom design method in order to generate a flat-top type pressure signature on the ground. The near-field pressure signatures of the airplane are calculated by using three-dimensional Euler equations. The sufficient number of grid points to capture the shock waves in the near-field is checked. These calculated near-field pressure signatures are then extrapolated to the ground by waveform parameter method. As a result of the calculation, it is shown that the airplane generates a flat-top type pressure signature, and its sonic-boom intensity is under 1 psf on the ground.
Author

Sonic Booms; Near Fields; Numerical Analysis; Aircraft Noise

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GENERAL

19970020903 Kyushu Univ., Faculty of Engineering., Fukuoka, Japan

Technology Reports of Kyushu University, Volume 68

Technology Reports of Kyushu University, volume 68, no. 2, March 1995; Mar. 1995; ISSN 0023-2718; 67p; In Japanese; Also announced as 19970020904 through 19970020905; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The reports in this issue address the following topics: a simulation model of a plasma in a small PIG ion source; a study of the compressive failure process in concrete by mesoscopic mechanics; classification of stations based on comprehensive view points of station equipment, the circumstances of passengers and land-use; higher order derivatives calculation method of the Uni-

versal Learning Network and its application to systems control; and an experimental study of dynamic stall phenomena around a 2-dimensional airfoil oscillating in pitch in low speed flow.
CASI
Japan; Research; Engineering; Plasma Physics; Aerodynamics; Materials Science

Subject Term Index

Personal Author Index

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